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REARVIEW MIRROR DISPLAY

FIELD OF THE INVENTION

The present invention relates to vehicle rearview mirrors, and more particularly relates to the display of information on a rearview mirror assembly.

BACKGROUND INFORMATION

Many types of vehicles such as cars and trucks include rearview mirrors mounted inside and/or outside of the vehicle. One type of conventional interior rearview mirror comprises a prismatic mirror that can be switched from a first orientation suitable for normal driving conditions to a second orientation which reduces glare caused by headlights of vehicles approaching from the rear.

Recently, electrochromic rearview mirrors have been developed which automatically change from a full reflectance mode during the day to a partial reflectance mode during the night for glare protection. Electrochromic rearview mirrors typically comprise a relatively thin electro-optic medium sandwiched and sealed between two glass elements. In most assemblies, when the electro-optic medium is electrically energized, it darkens and absorbs an increasing amount of light as the applied voltage is increased. When the electrical voltage is removed, the mirror returns to its clear state. Examples of such automatic rearview mirrors are disclosed in U.S. Patent Nos. 4,902,108, 4,917,477, 5,128,799, 5,202,787, 5,204,778, 5,278,693, 5,280,380, 5,282,077, 5,285,060, 5,294,376, 5,682,267, 5,689,370, 5,448,397, 5,451,822 and 5,818,625, each of which is assigned to the assignee of the present invention and each of which is incorporated herein by reference.

In the past, information such as the words "HEATED" or "OBJECTS IN MIRROR ARE CLOSER THAN THEY APPEAR" have been used on vehicle rearview mirrors. In addition, some types of automatic rearview mirrors have included compass and temperature readings. However, such conventional rearview mirror displays typically comprise a glossy planar surface which makes the display difficult to read. Furthermore, such conventional displays are often difficult or impossible to read by some occupants of a vehicle. For example, interior rearview mirrors are typically angled toward the driver and away from the front seat passenger, thereby obstructing the display from viewing by the front seat passenger. In addition, selectable information displays commonly used in automobile interiors comprise complex electronic assemblies. This type of display is not only expensive, but also more prone to failure due to the number and complexity of components.

The present invention has been developed in view of the foregoing, and to address other deficiencies of the prior art.

SUMMARY OF THE INVENTION

The present invention provides a vehicle rearview mirror assembly including a display which indicates a sensed condition inside or outside of the vehicle. In a preferred embodiment, the display indicates whether a passenger air bag is on or off. The display preferably includes a non-planar exterior surface which allows the display to be seen by all occupants of the vehicle, and which reduces unwanted glare.

An aspect of the present invention is to provide an air bag status indicating system for a vehicle. The system includes a vehicle occupant sensor, an air bag controller, and an air bag status display located on a rearview mirror assembly of the vehicle. The display indicates whether a vehicle air bag is active or inactive.

Another aspect of the present invention is to provide a rearview mirror assembly for a vehicle. The assembly includes a mirror, a bezel, and a non-planar display. The non-planar display may be located in the mirror and/or bezel. Preferably, the non-planar display includes a convex exterior surface having a defined radius of curvature.

These and other aspects of the present invention will be more apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a vehicle sensor and display system in accordance with an embodiment of the present invention.

Fig. 2 is a front elevational view of a rearview mirror including a passenger air bag status display in accordance with an embodiment of the present invention.

Fig. 3 is a partially schematic side sectional view illustrating a rearview mirror display in accordance with an embodiment of the present invention.

Fig. 4 is a front elevational view of a rearview mirror including a non-planar display in accordance with another embodiment of the present invention.

Fig. 5 is a bottom view of the rearview mirror of Fig. 4.

Fig. 6 is a side view of the rearview mirror of Fig. 4.

Fig. 7 is a front elevational view of a rearview mirror including a non-planar display in accordance with a further embodiment of the present invention.

Fig. 8 is a bottom view of the rearview mirror of Fig. 7.

Fig. 9 is a front elevational view of a rearview mirror including a non-planar display in accordance with another embodiment of the present invention.

Fig. 10 is a top view of the rearview mirror of Fig. 9.

Fig. 11 is a front elevational view of a rearview mirror including a non-planar display in accordance with a further embodiment of the present invention.

Fig. 12 is a top view of the rearview mirror of Fig. 11.

Fig. 13 is a partially schematic side sectional view illustrating a rearview mirror display in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

Fig. 1 is a schematic diagram illustrating a vehicle sensor and display system 1 in accordance with an embodiment of the present invention. The system 1 includes a passenger sensor 2, a passenger air bag controller 4, and a passenger air

bag status display 6. Alternatively, the display system could include a manual air bag shutoff switch in place of, or in addition to, the passenger sensor 2 and the air bag controller 4.

The passenger sensor 2 is used to determine whether a passenger is located at a particular position in a vehicle. For example, the passenger sensor 2 may be used to determine whether a passenger is seated in the right front passenger seat of a car or the like. The passenger sensor 2 may be used to determine the approximate size of a passenger in order to allow deactivation of the passenger's air bag if the passenger is less than a particular size. The sensor 2 may also be used to determine whether an infant or child seat is present, and to deactivate the air bag if such an infant or child seat is detected. Examples of suitable passenger sensors 2 include conventional infrared sensors, pressure sensors, and the like.

As shown in Fig. 1, the passenger sensor 2 is connected to the passenger air bag controller 4. Based on the signal provided by the passenger sensor 2, the controller 4 switches the passenger air bag on when a suitable size person is positioned in the passenger seat, and switches the air bag off when there is no passenger in the seat. Alternatively, the air bag status display 6 may be connected directly to the passenger sensor 2. Furthermore, the air bag display 6 may be connected to a manual air bag shutoff switch (not shown). The passenger air bag controller 4 is connected to the passenger air bag status display 6, as schematically shown in Fig. 1.

In accordance with the present invention, the passenger air bag status display 6 is located on a rearview mirror assembly. The display 6 may include any suitable indicia which alerts occupants of the vehicle that the passenger air bag is either active or inactive. For example, the display 6 may illuminate the words "PASSENGER AIR BAG OFF" when the passenger air bag has been deactivated by the controller 4 or by a manual switch. Alternatively, the display 6 may include any other symbols and/or alpha-numeric characters which adequately convey information concerning the status of the passenger air bag to at least one occupant of the vehicle.

In accordance with the preferred embodiment of the present invention, the display 6 is located on the interior rearview mirror assembly of a vehicle. Vehicle drivers generally look at the interior rearview mirror very

frequently. This frequent use makes the interior rearview mirror an optimal location for the display of critical safety information such as air bag status. By displaying safety information on the interior rearview mirror assembly, the driver or other occupants of the vehicle may be alerted to critical information which could otherwise go unnoticed.

Examples of suitable displays include LED, vacuum-fluorescent, and LCD displays. The display may comprise a filter with words such as "AIR BAG", an air bag symbol displayed on a surface which would become visible, more apparent or change color when the display is illuminated or backlighted, or an indicator light or series of lights in a location relative to a symbol or text indicative of an air bag which would announce the activation or deactivation of the air bag system by a change of status or color of the light(s). These indicators and displays could be located on the assembly supporting and encasing the mirror, in a module supported by but not integral with the mirror assembly, or in the mirror surface, as more fully described below.

Fig. 2 is a front elevational view of a rearview mirror 10 in accordance with an embodiment of the present invention. The rearview mirror 10 includes a mirror surface 11 surrounded by a bezel 12. In the embodiment shown in Fig. 2, the rearview mirror 10 is an automatic interior electrochromic mirror. However, other types of rearview mirrors including exterior mirrors and prismatic interior mirrors may be provided in accordance with the present invention.

As shown in Fig. 2, a chin 13 is located at the bottom of the bezel 12. A switch 14 may be provided inside the chin 13 in order to turn the automatic electrochromic rearview mirror 10 on or off. A conventional light sensor 15 may be located in the chin 13 or at any other suitable location. In addition, an indicator 16 located in the chin 13 is used to indicate whether the electrochromic rearview mirror 10 is on or off. Typically, the indicator 16 includes a light which is illuminated when the electrochromic rearview mirror 10 is on.

In the embodiment of Fig. 2, a passenger air bag status display 18 is located in the mirror surface 11. The display 18 includes the words "PASSENGER AIR BAG OFF". However, any other suitable symbolic or alpha-numeric indicia which adequately conveys the status of the passenger air bag may be used.

In the case of the mirror surface display 18, any suitable display can be located in or behind the mirror for viewing through the mirror assembly. The display 18 may comprise a substantially transparent section in the mirror. Part or all of the reflective surface may be removed from an area behind which an indicator light source is positioned. Removal of any other opaque elements in the aforementioned area would also be desirable so that the indicator or display can be viewed through the mirror. The removal of the reflective surface could create an indicator graphic pattern. For example, the words "PASSENGER AIR BAG OFF" could be etched away from the reflective surface partially or completely to allow transmission of light from a light source through the graphic pattern to thereby indicate the status of the air bag system.

Fig. 3 is a partially schematic side sectional view showing one type of rearview mirror display assembly 20 that may be used in the rearview mirror 11 of Fig. 2. The rearview mirror display assembly 20 includes a first glass sheet 21 which forms a viewing surface facing the occupant of a vehicle. The viewing surface of the first glass sheet 21 may be smooth, or may be provided with a matte texture. A second glass sheet 22 is spaced from the first glass sheet 21. A substantially transparent, electrically conductive layer 23 covers the interior side of the first glass sheet 21, while another substantially transparent, electrically conductive layer 24 covers the interior of the second glass sheet 22. An electrochromic composition 25 fills the gap between the glass sheets 21 and 22. A reflective layer 26 made of any suitable material such as silver, is provided on the surface of the second glass sheet 22. The display assembly 20 is thus provided as a part of an electrochromic rearview mirror. The various components of the electrochromic rearview mirror may be arranged and constructed as disclosed in the previously cited United States patents incorporated herein by reference.

As shown in Fig. 3, a portion of the reflective layer 26 is removed from the glass sheet 22 in order to provide an opening 27. An indicia panel 28 covers the opening 27. A light source 29 is arranged such that upon illumination, light travels through the indicia panel 28, opening 27, and the remaining layers 21-25 of the electrochromic mirror assembly toward the occupant of the vehicle. The indicia panel 28 may be unmarked, or may comprise any desired indicia such as alpha numeric symbols or the like. The indicia panel 28 may

optionally comprise a color filter. The light source 29 may comprise any suitable type of illuminator such as an LED, LCD, vacuum-fluorescent element, incandescent light, or the like.

The display 18 may thus be part of the silver coating that is etched/removed to form the individual letters or components of the graphics through which the light would pass to illuminate the lettering or graphics. The display 18 may further comprise lettering or graphics printed or otherwise applied to a cleared area in the silver where the graphics or lettering would be of a design to show contrast when illuminated. The graphics or display can be separate from the mirror element mounted behind the element such as a conventional LCD display, a vacuum-fluorescent display, a static mask through which light will pass to display graphics or lettering, or other display types.

A color filter may optionally be included between the display light source and the viewer, such as a color filter printed or bonded to the mirror surface, or a filter installed on the light source, or at any point therebetween. The light source could also be of a bandwidth narrower than full-spectrum visible light for the purpose of displaying a distinctive color through the display graphics to indicate the status of the air bag system.

In versions requiring removal of some of the silver surface, a portion rather than all of the silver can be removed in an area and still allow the display to be seen. One method is to remove a pattern such as a grid. This allows conduction across a substantial amount of the surface facilitating coloring and clearing of the electrochromic substance in that area proportional to the rest of the element. Another method is to allow breaks in letters and graphics to avoid closed islands in the surface.

In the embodiment of Fig. 2, the surface of the display 18 is flush with the surface of the mirror 11. Alternatively, the surface of the display 18 may be non-planar. For example, the surface of the display 18 may comprise a convex arc extending from the surface of the mirror 11.

In accordance with a preferred embodiment of the present invention, a non-planar display is provided on a rearview mirror assembly. As used herein, the term "non-planar display" means a display having a contoured exterior viewing

surface instead of a flat exterior surface. Preferred non-planar contoured display surfaces include curved or faceted convex configurations.

Figs. 4-6 illustrate a rearview mirror 30 having a non-planar display in accordance with a preferred embodiment of the present invention. The rearview mirror 30 is an automatic electrochromic mirror including a mirror surface 31 and a bezel 32. Although an electrochromic mirror is shown in Figs. 4-6, other types of mirrors such as prismatic rearview mirrors are within the scope of the present invention. A contoured chin 33 having a curved front face is located at the bottom of the bezel 32. The contoured chin 33 houses a compass switch 34, a mirror switch 35, a light sensor 36, and an on/off indicator 37. In this embodiment, a non-planar display 38 is located in the chin 33. As shown most clearly in Fig. 5, the surface of the non-planar display 38 is convex and conforms to the contoured surface of the chin 33.

The use of a convex non-planar display 38 provides substantially improved viewability of the information provided by the display. The curved exterior surface of the display 38 essentially prevents unwanted glare from surrounding light sources, and provides improved viewability to occupants of the vehicle. For example, both the driver and front passenger(s) of the vehicle can readily see the information provided by the display 38 without obstruction. In a preferred embodiment, the non-planar surface of the display 38 has a matte texture in order to further reduce unwanted glare.

A display such as a vacuum-fluorescent, LCD, LED, or the like may be mounted in the bezel or, preferably, behind a filter in the bezel. A static display may simply be illuminated, or the illumination color changed, to display information. This display offers several possible configurations. A preferred display comprises an opening in the bezel and a mask or label with graphics and/or lettering printed onto the surface to allow light to pass through the lettering or graphics portion of the label. Lettering or graphics molded or embossed into the bezel through which light could pass to illuminate the lettering or graphics may be used. A translucent bezel or portion of the bezel on which the graphics could be painted or printed to allow light to pass through only select parts may also be used. Furthermore, printed or molded graphics or lettering with a corresponding translucent or open section through which light could pass to indicate status may be

used. In addition, a status display of graphics and/or lettering with a corresponding light which illuminates or changes color may be used.

In the embodiment shown in Figs. 4-6, the rearview mirror 30 includes a compass reading 39 which indicates the direction in which the vehicle is oriented. The compass switch 34 may be used to turn the compass reading 39 on and off. As shown most clearly in Figs. 5 and 6, the rearview mirror 30 includes a housing 41 and a conventional mounting bracket 42. However, other mounting methods can be used.

Figs. 7 and 8 illustrate a rearview mirror 50 in accordance with another embodiment of the present invention. The electrochromic rearview mirror 50 includes a mirror surface 51 and a surrounding bezel 52. A chin 53 having a generally planar front face extends from the bottom of the bezel 52. The chin 53 houses a compass switch 54, a mirror switch 55, a light sensor 56, and an on/off indicator 57. A convex non-planar display 58 extends from the surface of the chin 53. A compass display window 59 is provided in the mirror surface 51. The rearview mirror 51 also includes a housing 61. The convex surface of the non-planar display 58 shown in Figs. 7 and 8 substantially improves visibility of the displayed message.

Figs. 9 and 10 illustrate a rearview mirror 70 in accordance with a further embodiment of the present invention. The electrochromic rearview mirror 70 includes a mirror surface 71 surrounded by a bezel 72. A chin 73 located at the bottom of the bezel 72 includes a mirror switch 74, a light sensor 75, and an on/off mirror indicator 76. A crown 77 having a substantially planar front surface is located at the top of the bezel 72. A convex non-planar display 78 is located in the crown 77. The rearview mirror 70 also includes a housing 81.

Figs. 11 and 12 illustrate another rearview mirror 90 in accordance with a further embodiment of the present invention. The rearview mirror 90 includes a mirror surface 91 surrounded by a bezel 92. A chin 93 located at the bottom of the bezel 92 houses a mirror switch 94, a light sensor 95 and an on/off mirror indicator 96. The right side of the bezel 92 includes an extension 97 having a non-planar display 98 therein. The rearview mirror 90 comprises a housing 99. In this embodiment, the non-planar display 98 is oriented such that a passenger

seated in the front right seat of a vehicle can easily see whether the passenger air bag is on or off.

Fig. 13 is a partially schematic side sectional view illustrating a rearview mirror non-planar display assembly 100 in accordance with an embodiment of the present invention. The non-planar display assembly 100 includes an electrochromic mirror assembly comprising a first glass sheet 101, a second glass sheet 102 spaced from the first glass sheet 101, and an electrochromic material 103 filling the gap between the glass sheets 101 and 102. A seal 104 extends between the glass sheets 101 and 102 in order to retain the electrochromic material 103 therebetween. Although not shown in Fig. 13, the electrochromic mirror assembly may include substantially transparent electrically conductive films on the interior surfaces of the glass sheets 101 and 102, and may comprise a reflective mirror surface positioned at any suitable location such as the exterior surface of the second glass sheet 102. Suitable types of electrochromic rearview mirror assemblies are disclosed in the previously cited United States patents which are incorporated herein by reference.

As shown in Fig. 13, a bezel 105 contacts the exterior viewing surface of the first glass sheet 101 of the electrochromic mirror assembly. A lamp holder 106 having a reflective interior surface is formed in the bezel 105. A light source assembly 107 is secured in the lamp holder 106. In the embodiment shown in Fig. 13, an LED 108 is provided as part of the light source assembly 107. Alternatively, any other suitable light source such as an electro-luminescent source, incandescent light, or the like may be used. An indicia panel 109 covers the lamp holder 106. The indicia panel 109 forms the exterior viewing surface of the display. In accordance with the preferred embodiment of the present invention, the indicia panel 109 comprises a convex exterior viewing surface defined by at least one radius of curvature, as more fully described below.

The indicia panel 109 shown in Fig. 13 may be unmarked or may comprise any desired graphics, alpha numeric symbols, or the like. The indicia panel 109 may optionally include a color filter.

Preferred non-planar displays of the present invention comprise a convex exterior viewing surface defined by at least one radius of curvature. The radius of curvature may be constant, or may vary, along the exterior surface of the

display. For example, in the embodiments shown in Figs. 4-10, the non-planar displays have an exterior curved surface of substantially constant radius defined by an arc swept around a substantially vertical axis. Such arcs are most readily seen in Fig. 8, element 58 and in Fig. 10, element 78. The radius of the arc typically ranges from about 1 to about 60 cm, more preferably from about 1.5 to about 15 cm. This geometry results in a display that is readily viewed by all occupants of the vehicle while reducing unwanted glare.

In the embodiments of Figs. 11-12, the non-planar display has a varying radius of curvature which substantially conforms to the curved bezel surface of the mirror. The non-planar display reduces glare and is readily viewable to at least the right front passenger of the vehicle.

Conventional planar displays have a high degree of first surface reflection, which decreases the contrast between the graphics of the display which are intended to be viewed and the reflected light from the surface. This degrades the ability for a passenger to view the displayed information, since the front seat passenger is usually seated in a position which can create a viewing angle up to 30° or more off of perpendicular to the mirror front surface. A non-planar display, as well as surface treatment such as a matte finish to decrease the reflection of the surface, increases the contrast of the display, especially when viewed at an angle. The curvature or the display also serves to orient the display, or a portion of the display, toward the passenger and therefore improve the visibility of the display. A low-glare surface, and a convex surface have the added benefit of reducing glare on the display surface for the driver and other occupants of the vehicle. Additionally, since the display surface is typically at the same angle as the mirror surface, glare from the headlamps of a following vehicle can also render a glossy, planar display unreadable.

Although the non-planar displays described in the specific embodiments herein are used to convey information concerning the status of a passenger air bag, other types of symbolic or alpha-numeric information may be displayed on rearview mirror assemblies in accordance with the present invention. For example, the status of other air bags or supplemental restraint systems in the vehicle may be displayed. Furthermore, information such as door ajar, fasten seat

belts, fuel mileage, time, temperature, heading, altitude, and the like may be displayed.

Whereas particular embodiments of this invention have been described above for purposes of illustration, it will be evident to those skilled in the art that numerous variations of this details of the present invention may be made without departing from the invention as defined in the appended claims.